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00Y-TR-61-21

MAY 1961

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OOAMA

AIRMUNITIONS TEST REPORT

HAZARD CLASSIFICATION OF M50
IGNITER FOR M58A2 ROCKET IN
GAR ID/2A

NOX
61-3-5



AIR FORCE (DPS, Ogden, Utah)

HAZARD CLASSIFICATION OF M50 IGNITER

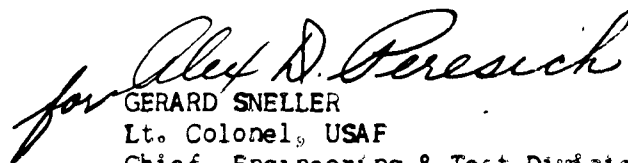
FOR M58A2 ROCKET MOTOR IN GAR 1D/2A

by

Paul P. Jennens

PUBLICATION REVIEW

This report has been reviewed and is approved


GERARD SNELLER
Lt. Colonel, USAF
Chief, Engineering & Test Division
2705th Airmunitions Wing

MAY 1961

2705TH AIRMUNITIONS WING
OGDEN AIR MATERIEL AREA
AIR FORCE LOGISTICS COMMAND
UNITED STATES AIR FORCE
Hill Air Force Base, Utah

NOTICES

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The conclusions and recommendations made in this report are not to be considered directive in nature. This type information becomes official only when published in Technical Orders and/or other applicable Air Force publications.

ADMINISTRATIVE DATA

PURPOSE OF TESTS:

To determine the quantity distance, storage compatibility, and shipping classifications of the M50 Igniter.

MANUFACTURER:

Thiokol Chemical Corporation

MANUFACTURERS - MODEL NUMBER:

Igniter, M50, for M58A2 Rocket Motor in GAR 1A/2D Missile Container, Shipping, Part Number FR-184-83

DRAWINGS AND SPECIFICATIONS:

M50 Igniter, Thiokol Chemical Corp. Specification SP87

QUANTITY OF ITEMS TESTED:

48 - M50 Igniters with Shipping Containers

SECURITY CLASSIFICATION:

Unclassified

DATE TEST COMPLETED:

12 January 1961

TEST CONDUCTED BY:

OCAMA (OOYET) 2705th Airmunitions Wing

Test Director: Hoyt O. Brown, Major, USAF

Project Officer: Richard C. Stanland, 2d Lt. USAF

DISPOSITION OF SPECIMENS:

All metal parts generated were inspected and certified inert in accordance with Technical Order 11C-1-3, and then turned over to the salvage officer as scrap metal.

ABSTRACT

These tests were required to determine the hazard classifications for storage and shipment. Separate classifications were required for Quantity-Distance, Storage Compatibility, and ICC Shipping.

A series of six detonation tests were conducted to determine if the igniter would detonate within its individual shipping container and if there would be propagation from one container to another. Also an open fire test was conducted to demonstrate any detonation possibilities.

Only normal type ignition occurred in all seven tests. The igniter shipping containers burst along a soldered joint from the pressure of the blasting cap and igniter. No measurable overpressures were recorded at a 5 foot distance. The time expended for the igniters in metal shipping containers (shipped 12 to a box) to cook-off in an open fire test ranged from 6 to 10 minutes.

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INTRODUCTION

A requirement was placed upon the Explosives Evaluation Branch OOEY, of the 2705th Airmunitions Wing, OOEY, by the Safety and Inspection Branch, OOEYSS, to conduct these Hazard Classification tests on the M50/M50A1 Igniter (M58A2 Rocket Motor for GAR 1D/2A). These tests were conducted to determine quantity-distance, storage compatibility and the ICC shipping classifications.

The Test Branch (OOYET), Engineering and Test Division (OOYE) conducted the tests under Test Directive OOEY-22-60. The igniters were subjected to detonation and fire tests in shipping and storage configuration as outlined in Technical Order 11A-1-47, Explosives Hazard Classification Procedures.

Forty-two igniters in their individual, cylindrical metal shipping containers were utilized in six separate tests to determine if the igniters would detonate within a container and between shipping containers. Also six igniters in their individual shipping containers were used in a Cook-off (open-fire) test.

DESCRIPTION

The M50 Igniter is used to ignite the M58A2 Rocket Motor in the GAR 1D/2A Missile. It is a "jelly roll" type igniter containing a 50 gram ignition charge (a mixture of Boron, and Potassium Perchlorate). The charge is sprayed on a film in successive layers, which is rolled and placed into a plastic tube 5/8-inch in diameter and 16 inches long. Two M107 squibs are installed with one at each end. The igniter is shipped in a cylindrical metal can 2.5 inches in diameter and 22.5 inches long. The igniter is supported by a plastic saddle about 1/32-inch thick and by styrafoam inserts. The saddle twists into and locks in the metal can forming the cap of the container as shown in Figure 1.

INSTRUMENTATION

Recording Equipment:

Recording System	Wiancko-Carrier
Oscillograph	Consolidated
Calibration Equipment	Morehouse
Blast Gauges, 20 & 5 psi	Wiancko

System Accuracies

The static test data are accurate with the following limitations:

Time	0.001 Second
Pressure	$\pm 2\%$

Metal Can

Elastic Saddle-Cover

M50 Igniter



GENERAL PROCEDURE

The following tests were conducted to determine the hazard classification for the M50 Igniter:

<u>TEST</u>	<u>TYPE OF TEST</u>	<u>NUMBER OF IGNITERS</u>	<u>METHOD OF ACTIVATION</u>
1	Detonation	1	Blasting Cap
2	Ignition	1	Igniter Squib Circuit
3	Detonation	2	Blasting Cap
4	Ignition	2	Igniter Squib Circuit
5	Detonation	18	Blasting Cap
6	Detonation	18	Blasting Cap
7	Storage Fire	6	JP-4 Fuel - Open Fire

The blasting caps used in the Detonation Tests were "Blasting Cap, Special Electric, Type II," (#8 Blasting Caps).

Blast pressure gauges were set up on a radius at 5, 10, 15, and 20 feet from the test center for all the detonation tests (Figure 2). The gauges at 5 and 10 feet were calibrated to 20 psi and the gauges at 15 and 20 feet were calibrated to 5 psi.

The tests were conducted in a series prior to determining the results of any of the tests. The Procedure and Test Results are presented separately for each test.

TEST NUMBER 1

PROCEDURE.

In the first test for detonation, a blasting cap (special electric, Type II - #8) was placed against the igniter inside the cylindrical shipping container. The igniter was surrounded by 11 other containers in a wooden box to simulate shipping and storage conditions (normally the igniters are shipped 12 to a box). The 11 containers were filled with sand to confine the tested item. This confinement increases severity of the test conditions. Figure 3 shows the box of 12 containers.

TEST RESULTS.

When the blasting cap was electrically detonated, the igniter was ignited. The wooden box was opened up and the contents dispersed by combustion gases. The metal container in which the blasting cap was discharged was broken open at the soldered seam. The other containers were dented but none were punctured. No over-pressures were recorded by the gauges at 5, 10, 15, or 20 feet from the igniter. Figure 4 shows the dispersion of the contents of the wooden box. No metallic fragments (pieces) were found.



Figure 2. Instrument Set-Up.



Figure J. Test Set-Up (12 Igniters, K50 in Shipping Containers Packed in Wooden Box).



Figure 4. Results of Test 1.

TEST NUMBER 2

PROCEDURE.

The second test was a repeat of the first test except that the igniter was purposely initiated by its own circuit to compare results with Test 1.

TEST RESULTS.

When the igniter was ignited through its own squib circuit, the noise was louder than in the first test and the containers were found scattered over a larger area. The wooden box was opened up and the contents dispersed. Figure 5 shows the dispersion and Figure 6 shows the difference between the primed container and one of the sand-filled containers. There were no metallic fragments (pieces) found since the one container was broken open only at soldered seam. There was no over-pressure recorded by the gauge at five feet from the igniter. This functioning was a normal ignition and was used for comparison of the severity of damage caused by a blasting cap (and igniter) in the other tests.

TEST NUMBER 3

PROCEDURE.

Two igniters in their shipping containers were placed adjacent to each other in the wooden box for 12 igniters. The remaining 10 containers in the wooden box were filled with sand. These sand-filled containers surrounded the two with igniters to confine the test items. A blasting cap was detonated in one of the containers which included an igniter.

TEST RESULTS.

When the blasting cap was detonated, the wooden box was opened up and the contents dispersed. No over-pressures were recorded at five feet from the igniters. The container burst due to the blasting cap (and igniter). The remaining containers were dented but not pierced. The primed container was 10 feet away. There was no propagation to the adjacent igniter nor was the adjacent igniter initiated.



Figure 5. Results of Test 2.

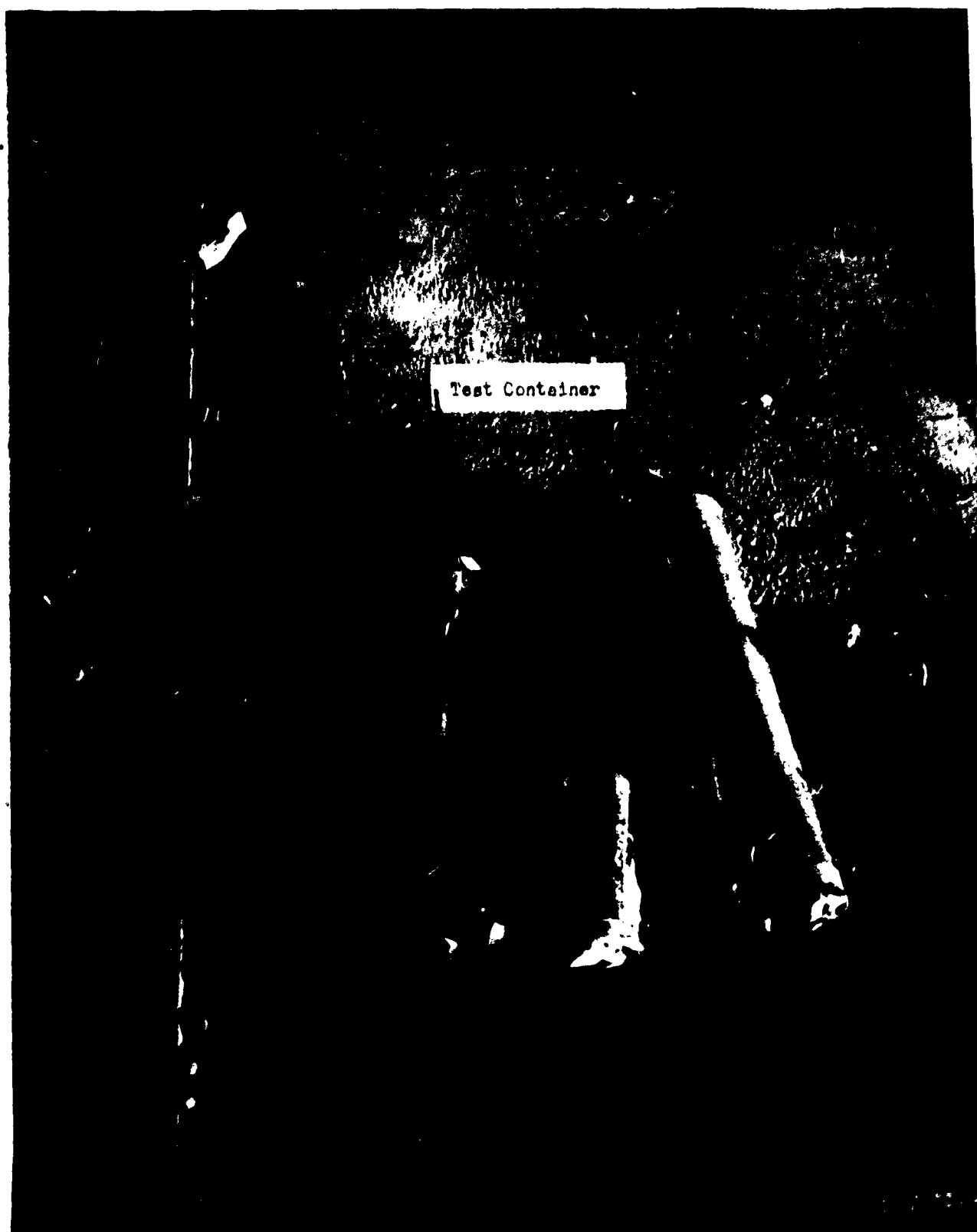


Figure 6. Igniter Shipping Containers of Test 2.

TEST NUMBER 4

PROCEDURE.

This was a repeat of the third test except that one of the two igniters was purposely initiated through its own squib circuit to compare with Test Number 3.

TEST RESULTS.

When the igniter was initiated by its own circuit the box opened up and the contents dispersed. The results were similar to Test Number 3. There was no initiation of the adjacent igniter. No over-pressures were recorded by the gauges at five feet from the igniters. Figures 7 and 8 show typical results of Tests 3 and 4.

TEST NUMBERS 5 AND 6

PROCEDURE.

Six live igniters in their shipping containers were placed in a wooden box. One of the igniters was primed with a blasting cap. The wooden box was restrained or confined on all sides by other boxes which had a row of igniters in positions adjacent to the igniters in the first box (Figures 9 and 10). The remaining volume of the boxes was filled with sand. Figure 11 shows the igniters in the container cans less the saddle which forms the cover of the containers. Note that the containers are sealed with tape.

TEST RESULTS.

When the blasting cap was detonated in one of the containers which included an igniter, the wooden box was opened up and the contents were dispersed within an area of a 5 foot radius (Figure 12). There was no propagation in the center box but two other igniters became ignited in Test 5 and one other igniter became ignited in Test 6. There was no propagation to the igniters in the adjacent boxes. There was no over-pressures recorded at five feet from the test center. Figure 13 is typical of the damage to the containers.

In these detonation tests the containers were sealed with tape. It is concluded that if the igniters were installed in complete containers with the plastic saddle-cover there would be no ignition of other (adjacent) igniters in similar tests. Results of Test 3 indicate that there was no initiation (ignition) of an adjacent igniter. The severity of the confinement in Tests 5 and 6 may have been a contributing factor in that some of the other igniters in the same box did become ignited.



Figure 7. Results of Tests 3 or 4 (Typical).



Figure 8. Igniter Shipping Containers of Test 3 or 4 (Typical).

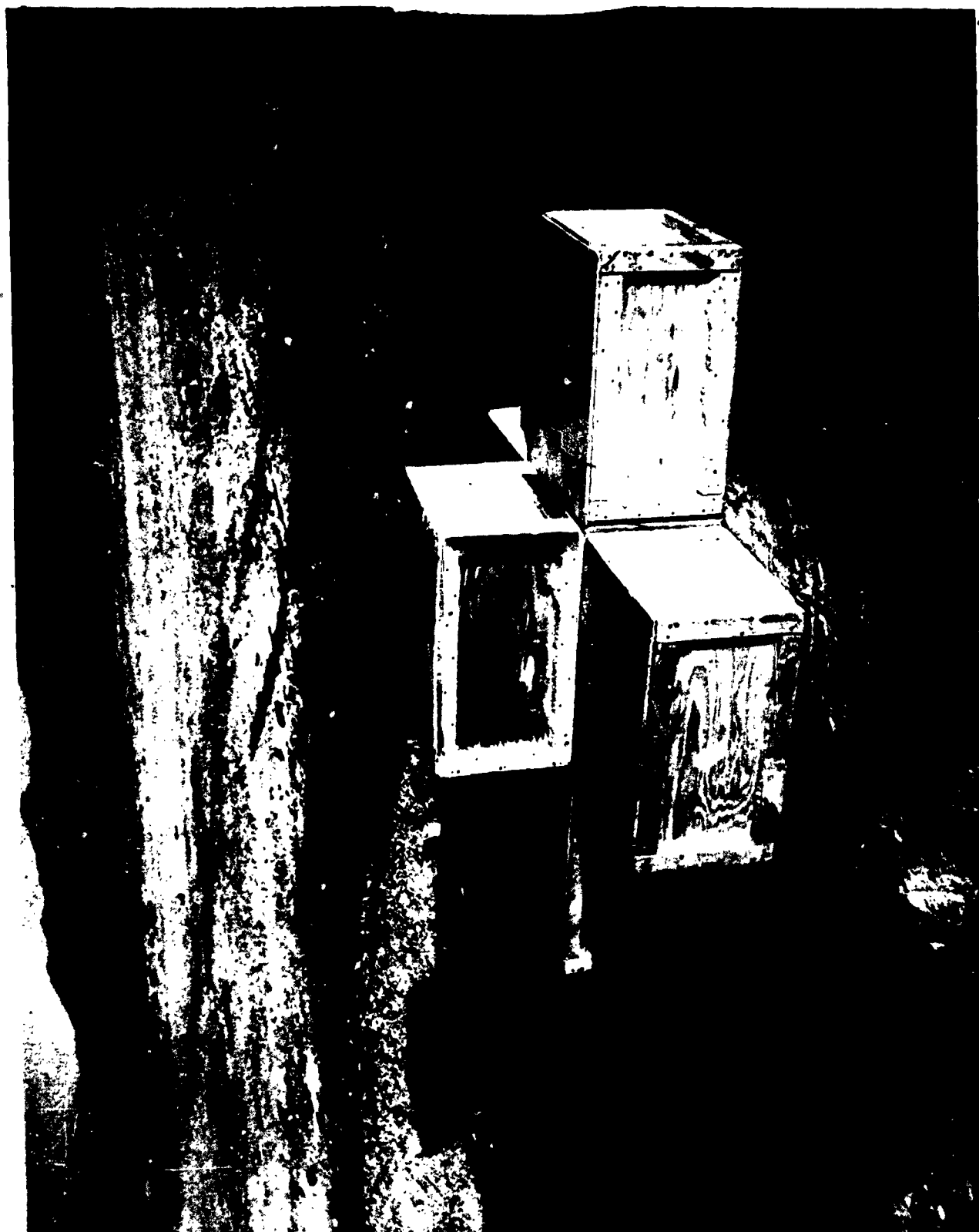


Figure 9. Test Set-Up for Test 5 and 6.

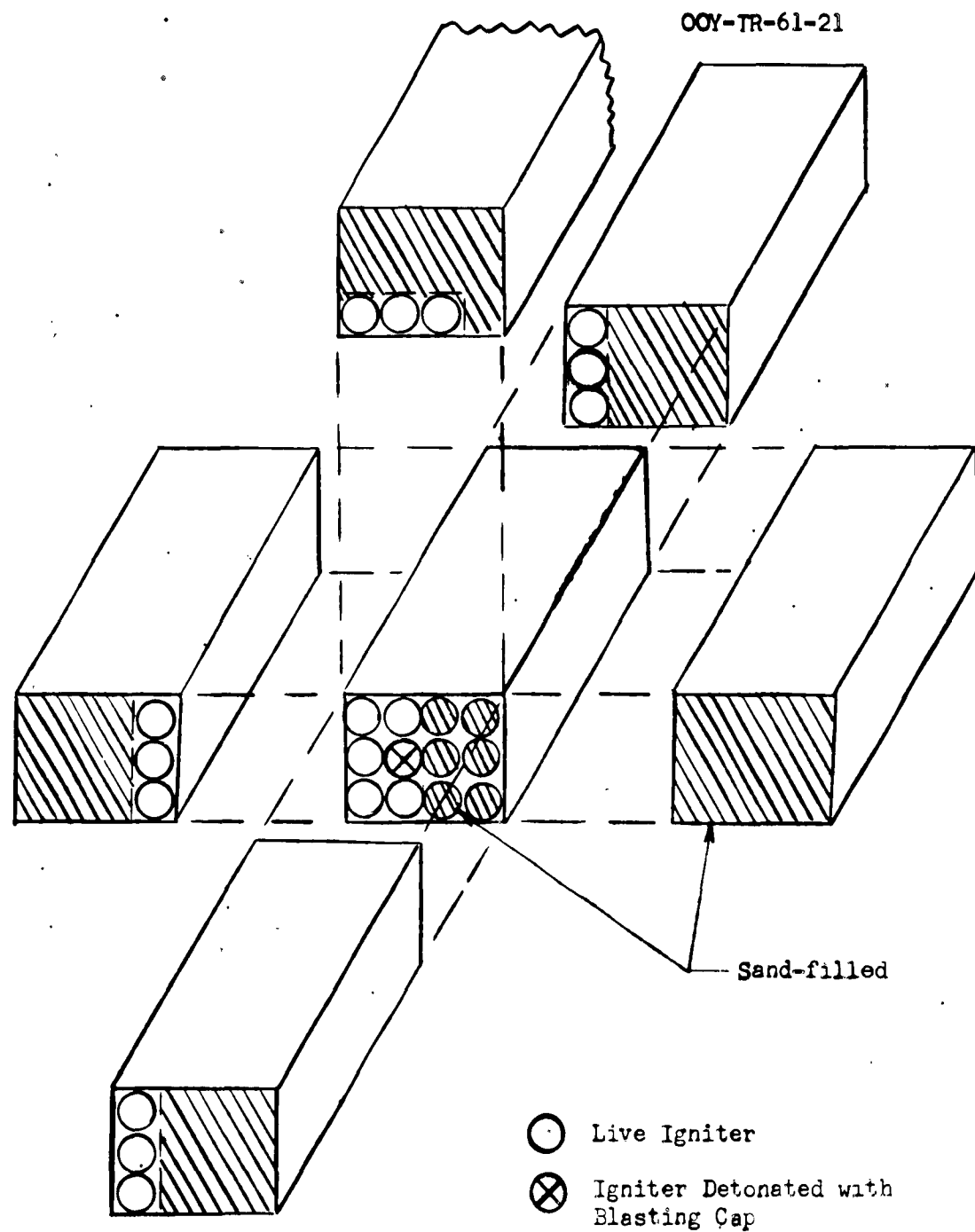


FIGURE 10. Exploded View of Detonation Tests 5 and 6 - Propagation Between Boxes.

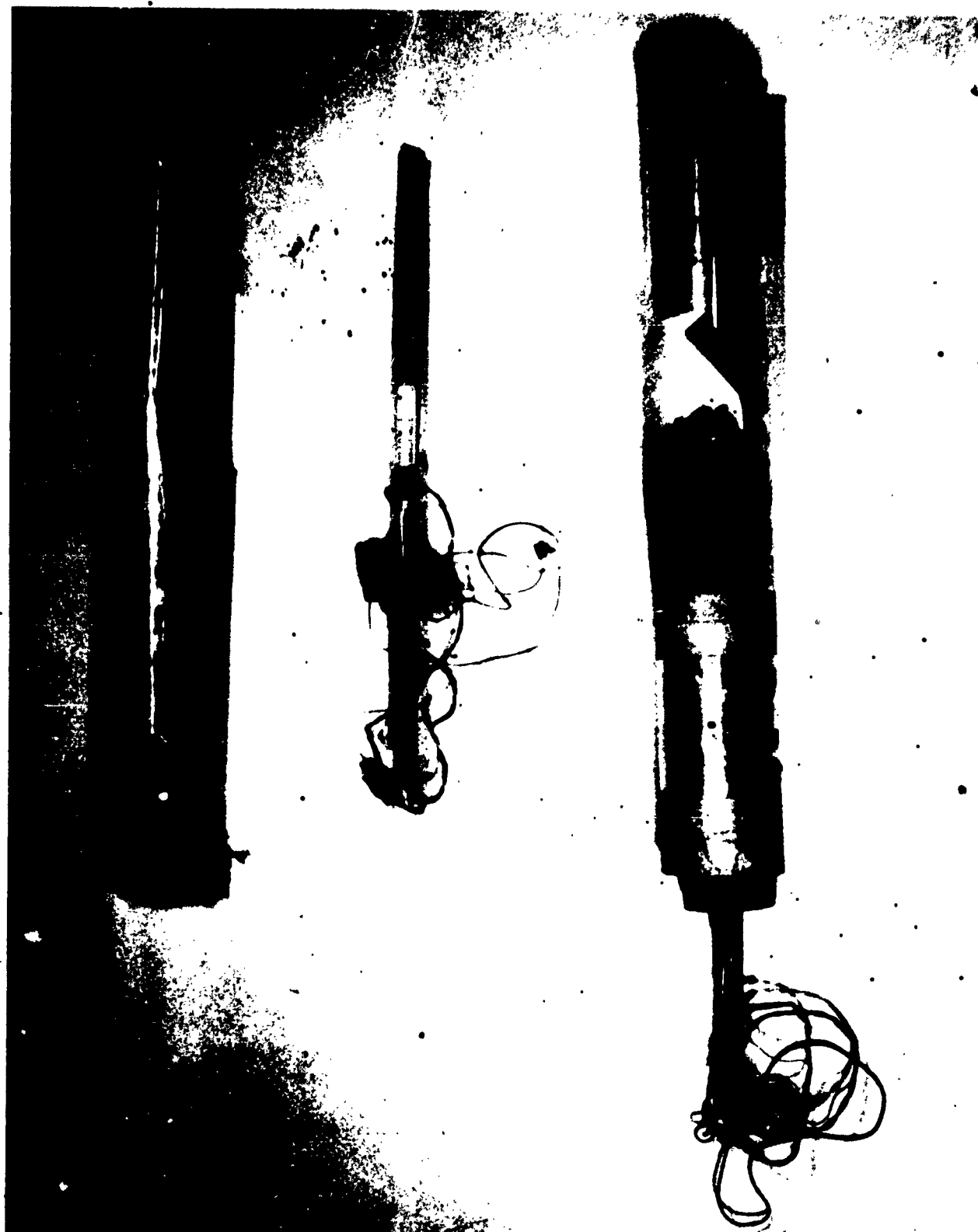


Figure 11. Igniter and Shipping Container Used in These Tests (Plastic
Casing Removed for Inspection)



Figure 12. Results of Tests 5 or 6 (Typical).



Figure 13. Results of Tests 5 or 6 Close-Up (Typical).

TEST NUMBER 7

PROCEDURE.

A simulated storage fire (open fire) test was conducted on six igniters in their containers. The containers were banded together and placed inside a wooden box. The wooden box was placed on a crib of wood (Figure 14). The box and pile of lumber were soaked with about five gallons of JP-4 fuel. The fire was started electrically by using an M114 Igniting Flare.

TEST RESULTS.

The igniters functioned in the range of six to 10 minutes after the fire was started. The remains of the fire are shown in Figure 15. The metal containers were found within 20 feet of the fire. Five were opened up by the pressure and one was slightly propelled by the exhaust gases.

DISCUSSION

1. All of the tests indicate that only normal burning (ignition) occurred in the tests to determine if the igniters would detonate. The blasting caps which were detonated inside the shipping container (against the igniter) would only ignite the charge of the igniter in somewhat the same manner as do the igniter's electrical squibs. The results were similar to the ignition tests of the igniter under identical test conditions when the igniters were initiated through their own squib circuit.

2. The gases of combustion formed during ignition of the igniters, both by normal ignition or by activation with a blasting cap, raise the pressure in the containers which in turn opens up the container at the soldered seam or ruptures the containers. The wooden boxes were opened up and the containers dispersed as a result of the pressure on the sides of the box. No over-pressures were recorded at five feet from the test center. The dispersing of the box and its contents relieves any pressure build-up, which in turn relieves the potential fire hazard of these igniters. Very severe confinement was used in these tests which simulates the worst possible conditions that could be expected.

3. Fragment hazard was slight as no metal parts are in the igniter. The metal shipping container opened up in most cases at the soldered seam or burst in large pieces which traveled to a maximum of 20 feet. The wooden box sides traveled less than 10 feet.

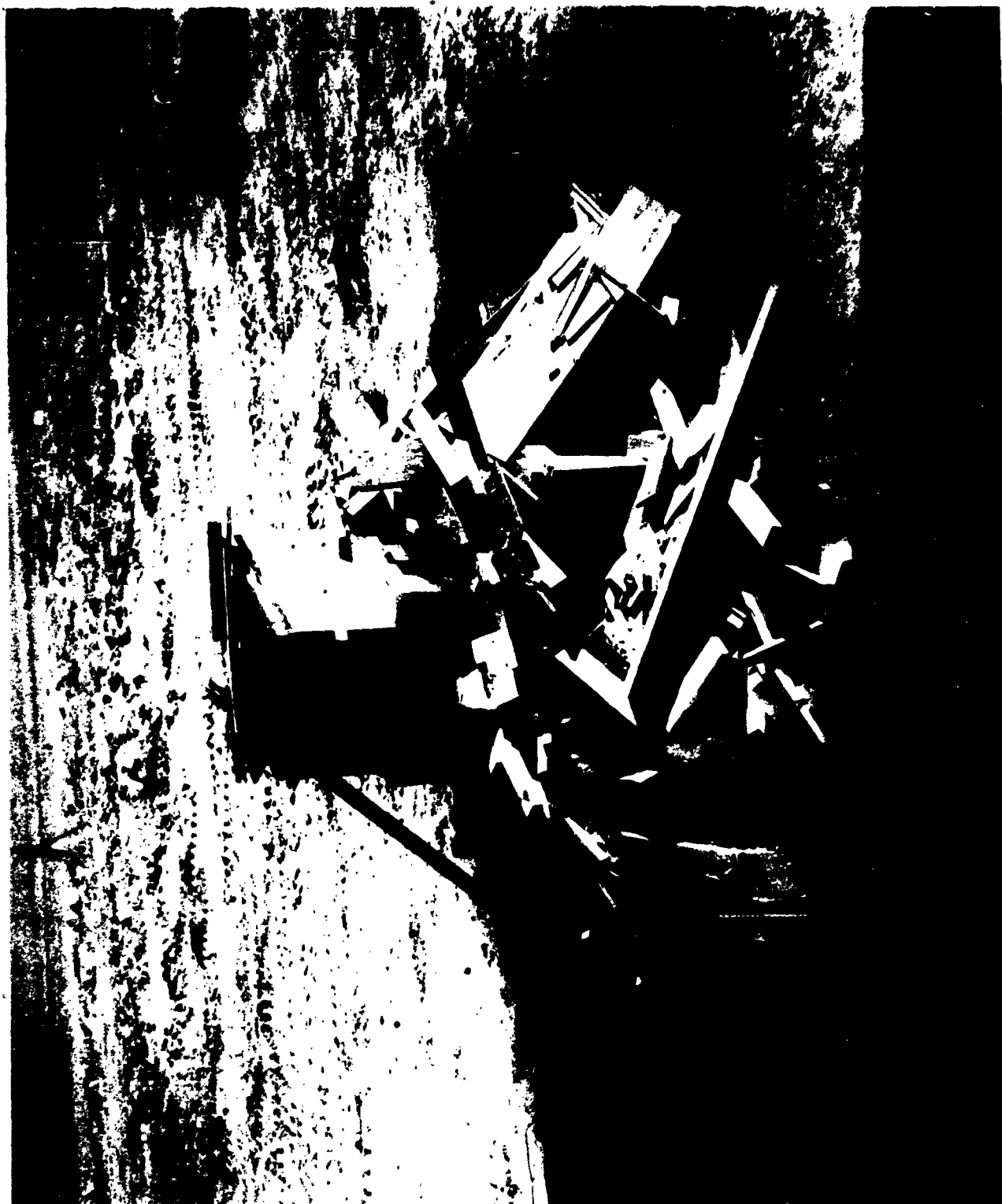


Figure 14. Test Set-U_i for Test 7 (Cook-Cff).



Figure 15. Results of Test 7.

CONCLUSIONS

1. The M50 Igniter will not detonate within its own metal shipping container when primed with a blasting cap inside the container.
2. The M50 Igniter will not propagate from container to container when primed with a blasting cap inside the container. It will not propagate from box to box (12 containers per box).
3. The M50 Igniter will cook-off by external heat such as an open fire. In this test the time of cook-off ranged from six to ten minutes. Normal ignition was indicated.

RECOMMENDATIONS

1. It is recommended that the following hazard classifications be assigned to the M50/M50A1 Igniter for storage and shipping:

Quantity Distance	Class 2
Storage Compatibility	Group B
ICC Shipping	Class F
ICC Marking	"Igniter, Jet Thrust"

2. The classifications Quantity-Distance Class 2 and ICC Class B are recommended whether shipped separately or assembled in the M58A2 Rocket Motor. (The M58A2 Rocket Motor is also classified Quantity-Distance Class 2 and ICC Class B.)

DISTRIBUTION LIST

1 Dep IG of Safety, Hq USAF (AFIGS), Norton AFB, Calif
 1 Hq USAF (AFMSS-AE), Wash 25, DC
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 1 Philadelphia APD (Thiokol Chem Corp, J.J. Florek, Elkton, Md)
 1 US Army Missile Command (Redstone Arsenal - ORDXR-00) (A.B.Treffer, Thiokol Chem Corp), Huntsville, Ala
 1 Bureau of Explosives, 63 Vesey St, New York 7, NY
 1 Commandant, U.S. Coast Guard, Wash 25, DC
 1 AFSC BSD (BSRO-3), Los Angeles, 45, Calif
 1 CO US Naval Nuclear Ordnance Evaluation Unit (CODE 402), Kirtland AFB, NMex

<p>AD 2705th Air Operations Wing (COAMA), Hill Air Force Base, Utah HAZARD CLASSIFICATION OF M50 IGNITER FOR MOSA2 ROCKET MOTOR IN CAR 1D 2A, by Paul P. Jennings, May 1961, 42p incl. figures. (Unclassified Report (COV-TR-61-21))</p> <p>These tests were required to determine the hazard classifications for storage and shipment. Separate classifications were required for Quantity-Distance, Storage Compatibility, and ICC Shipping. A series of six detonation tests were conducted to determine if the igniter would detonate within its individual shipping container and if there would be propagation from one container to another. Also an open fire test was conducted to demonstrate air detonation possibilities. Only normal type ignition occurred in all seven tests. The igniter shipping containers burst along a soldered joint from the pressure of the blasting cap and igniter. No measurable over-pressures were recorded at a 5 foot distance. The time expended for the igniters in metal shipping containers (shipped 12 to a box) to cook-off in an open fire test ranged from 6 to 10 minutes.</p>	<p>UNCLASSIFIED</p> <p>1. Igniters 1. Paul P. Jennings</p>	<p>UNCLASSIFIED</p> <p>1. Igniters 1. Paul P. Jennings</p>
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